Extruded foam sheets from styrene acrylonitrile copolymers

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Production of expanded styrene/acrylonitrile copolymer plates by extrusion and foaming involves the use of water in the foaming agent.

We claim:

1. A process for producing foam sheets based on styrene-acrylonitrile copolymers by extruding a polymer melt comprising blowing agent and then foaming, which comprises using water as blowing agent or blowing agent component.

2. A process as claimed in claim 1, wherein the amount of the blowing agent added to the polymer melt is from 0.5 to 15% by weight, based on the polymer melt.

3. A process as claimed in claim 1, where in from 0.2 to 3% by weight of water and from 0.5 to 5% by weight of carbon dioxide, based in each case on the polymer melt, are added as blowing agent to the polymer melt.

4. A foam sheet obtainable by extruding a polymer melt comprising blowing agent, which comprises at least 60% by weight of a styrene-acrylonitrile copolymer.

5. A foam sheet as claimed in claim 4, wherein the styrene-acrylonitrile copolymer is composed of from 10 to 50% by weight of acrylonitrile and from 50 to 90% by weight of styrene.

6. A foam sheet as claimed in claim 4, wherein the styrene-acrylonitrile copolymer is composed of a graft copolymer of styrene and acrylonitrile on an elastomeric polymer.

7. A foam sheet as claimed in any of claims 4 to 6, whose density is from 10 to 400 g/l.

8. A foam sheet as claimed in any of claims 4 to 7, which has a cross section of at least 20 cm^2.

Foam sheets with improved solvent resistance

The invention relates to a process for producing foam sheets based on styrene-acrylonitrile copolymers by extruding a polymer melt comprising blowing agent and then foaming, and a foam sheet which comprises at least 60% by weight of a styrene-acrylonitrile copolymer.

Extruded polystyrene foams (XPSs) are widely used for the insulation of buildings and of parts of buildings. Because these foams can also come into contact with mineral oils, especially with liquid hydrocarbons, it was an object of the invention to improve the mineral-oil resistance of XPS sheets.

Recently, for environmental reasons, halogen-free blowing agents have been used for the production of XPS sheets, CO_2-containing blowing agent mixtures being preferred. However, these blowing agents have less expanding action than conventional blowing agents based on halogenated hydrocarbons, making the production of relatively thick foam sheets difficult when halogen-free blowing agents are used. Another object of the invention was therefore to improve the expanding action of halogen-free blowing agents.

Foam sheets based on styrene polymers with improved mineral-oil resistance have been disclosed in DE-A 196 37 366. As main component, they comprise polystyrene with from 5 to 50% by weight replacement by styrene-acrylonitrile copolymers (SANs). The blowing agent used preferably comprises a combination of 3.5% by weight of carbon dioxide (CO_2) and 3% by weight of ethanol.

It is an object of the present invention to find a process which produces extruded foam sheets based on styrene polymers and which can be carried out using environmentally compatible and predominantly non-combustible blowing agents, and which, in particular when use is made of styrene polymers with a very high content of styrene-acrylonitrile copolymers, gives foam sheets with good solvent resistance.

We have found that this object is achieved by finding a process for producing foam sheets based on styrene-acrylonitrile copolymers by extruding a polymer melt comprising blowing agent and then foaming, where water is used as blowing agent or blowing agent component.

Besides water, it is in principle possible to use the conventional inert gases, such as carbon dioxide (CO_2), nitrogen, or argon, or aliphatic C_3-C_6 hydrocarbons, such as propane, butane, pentane, hexane, or aliphatic alcohols or aliphatic ketones with a boiling point of from 56 to 100°C, for example methanol, ethanol, propanol, isopropanol, butanol, acetone, or methylacetone, or aliphatic esters, such as methyl acetate or ethyl acetate, or halogenated, in particular fluorinated, hydrocarbons (for example 134a or 152a), or chemical blowing agents, as additional blowing agents. It is particularly preferable to use halogen-free blowing agents, in particular water, CO_2, isobutane, acetone, and ethanol.

The amount of blowing agent depends on the desired density of the foam sheets. Amounts of from 0.5 to 15% by weight, preferably from 3 to 12% by weight, of the blowing agent, based on the polymer melt, are generally added to the polymer melt.

It is preferable to use water and carbon dioxide together as blowing agent. From 0.2 to 3% by weight of water and from 0.5 to 5% by weight of carbon dioxide, in each case based on the polymer melt, are added here to the polymer melt. In addition, it is particularly preferable to add from 0.5 to 5% by weight of an aliphatic C_3-C_6 hydrocarbon, of an aliphatic alcohol or aliphatic ketone with a boiling point of from 56 to 100°C.

Particularly solvent-resistant foam sheets comprise at least 60% by weight, preferably from 80 to 100% by weight, of a styrene-acrylonitrile copolymer. The styrene-acrylonitrile copolymer is preferably composed of from 10 to 50% by weight of acrylonitrile and from 50 to 90% by weight of styrene. Preference is given to binary styrene-acrylonitrile copolymers (SANs), terpolymers with other comonomers, e.g. methyl methacrylate, butyl acrylate or butadiene, and also graft copolymers of styrene and acrylonitrile on an elastomeric polymer, such as polybutadiene, or a polyacrylate, e.g. acrylonitrile-butadiene-styrene polymers (ABSs) or acrylonitrile-styrene-acrylate polymers (ASAs).

The inventive foam sheets preferably have a density of from 10 to 400 g/l, in particular from 20 to 150 g/l, and a cross section of at least 20 cm^2.

Other conventional additives and/or auxiliaries which may be added to the polymer melt are antistatic agents, stabilizers, dyes, fillers, flame retardants, and/or nucleating agents, the amounts of these being the conventional amounts.

Examples:

Example 1:

A styrene-acrylonitrile copolymer (SAN) with 35% by weight of acrylonitrile was continuously fed together with 0.5% by weight of talc to a melt compounding extruder. 4% by weight of CO_2 and 1% by weight of water, based in each case on the polymer melt, were continuously fed through an inlet aperture in the compounding extruder. The polymer melt comprising blowing agent was cooled to 144.4°C in a downstream cooling extruder and extruded through a slot die. The foaming melt was shaped in a calibrator to give foam sheets with a thickness of 44 mm and with a density of 32 g/l.

Examples 2 – 14:

Example 1 was repeated, using the amounts of blowing agent given in table 1 in % by weight, based on the polymer melt. Examples 11 to 14 were carried out using 1% by weight of a third blowing agent component (isobutane, acetone and, respectively, ethanol). The polymer melt comprising blowing agent was cooled to the stated foam temperature (TF) in a downstream cooling extruder, and extruded through a slot die. The foaming melt was shaped in a calibrator to give foam sheets. The experimental parameters and results are shown in table 1.

Comparative experiments C1 – C3 were carried out in a manner similar to example 1, but with only CO_2 as blowing agent.

Table 1:

Ex.	CO_2 [%]	H_2O [%]	TF [°C]	Density [g/l]	Remarks
C1	3.5		152.2	--	Foam collapses
C2	4.0		149.7	--	Foam collapses
C3	4.6		147.3	--	Foam collapses
1	4.0	1.0	144.4	32.0	
2	1.2	1.2	149.2	81.9	
3	1.6	1.0	148.4	71.2	
4	2.4	1.0	146.2	54.4	
5	3.2	1.0	145.3	41.1	
6	4.0	1.0	144.4	32.0	
7	4.2	1.25	142.6	32.7	
8	4.2	1.50	141.3	31.7	
9	4.2	1.80	139.9	31.3	
10	4.0	1.0	144.4	32.0	
11	4.2	1.8	139.9	31.3	
12	4.0	1.0	141.3	28.1	1% isobutane
13	4.0	1.0	140.4	29.6	1% acetone
14	4.0	1.0	140.9	29.9	1% ethanol

Foam sheets with improved solvent resistance

Abstract

A process for producing foam sheets based on styrene-acrylonitrile copolymers by extruding a polymer melt comprising water as blowing agent or blowing agent component and then foaming, and a foam sheet which comprises at least 60% by weight of a styrene-acrylonitrile copolymer.